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Description

A method for coding positions of data elements in a data structure

The invention relates to a method for coding positions of data elements in a data structure.

Data structures frequently contain data elements which are to be differentiated by means of their positions with respect to each other. Position coding methods make this possible by allocating position codes to all data elements in a predetermined sequence.

A position coding method is described in [1] which is employed in a method for binary coding of XML data. This method uses XML schema definitions (in the context of a standardized MPEG-7 method, for example) in order to generate the codes for the individual data elements of the XML description. In this respect, individual elements or element groups of the same type as defined by the XML schema definition can occur several times in the document. In this case, a position code (PC) is transmitted. The position code comprises the binary representation of a whole number which specifies the position with regard to the adjacent elements. The position code is associated with the element on the basis of the position with respect to the adjacent elements in the document to be coded. This has the advantage that the position code of an element is preserved irrespective of the sequence in which adjacent elements are transmitted. Elements can therefore be lost in transmission without this affecting the position codes or the position of the elements which are subsequently decoded by means of a decoder.

A disadvantage of this known method is that the XML document must be known at the time of coding since no new positions can be inserted

with the previously existing position coding; instead, new positions can just be appended. This is a disadvantage especially when an XML document is already to be coded or transmitted while it is being created, for example in live transmissions according to a transmission standard, e.g. MPEG-4 or MPEG-7.

For the purposes of solving this problem, gaps can be left between the position codes used, which can be filled when needed. In the case of live coding especially, however, the need-based readiness of such gaps which must be defined in advance is difficult to predict. Additionally, the overall quantity of possible gaps is limited by the XML schema definition in many cases. Then, if no more position codes kept free by such gaps are available at the position to be inserted, all the adjacent elements already sent have to be transmitted again with newly generated position codes. This frequently occurs especially in the case of a plurality of data elements of the same type, e.g. in the case of identical elements or element groups occurring several times in a document. The consequence is a marked deterioration in coding efficiency and also a markedly increased processing overhead both at the coder and also at the decoder.

The object of the invention is therefore to create a method and a device for coding positions of data elements in a data structure in which the positions of newly added data elements can be coded in a simple and efficient manner.

This object is achieved by the method according to Claim 1 or 2 and the device according to Claim 13 or 14. Advantageous versions of the invention are described in the sub-claims.

The method according to the invention has the advantage that the position coding is robust with respect to data loss since position

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The method according to the invention has the advantage that the position coding is robust with respect to data loss since position

codes are retained. At the same time, where the method is used for coding XML documents, dynamic documents which are generated during the coding process can be coded efficiently. This is made possible by the fact that new positions can be coded between existing positions without elements and their position codes having to be transmitted again.

In the following, an embodiment of the invention is explained on the basis of the enclosed drawings.

The diagrams show:

Fig. 1 A representation of a position code for a data element, where the position code has been generated with the aid of the method according to the invention;

Fig. 2 A data structure where position codes are associated with the data elements, which position codes have been generated with the aid of the method according to the invention;

Fig. 3 The data structure shown in Fig. 2, where two new data elements have been added.

In the embodiment of the invention considered in the following, position codes are associated with the data elements of the data structure in ascending order of the data element positions, which position codes also comprise rational numbers in a predetermined value range arranged in ascending order. Then, if a position between two existing positions is to be addressed, this is always possible since an infinitesimal quantity of rational numbers always exists between two given rational numbers R_1 and R_2 where $R_1 \neq R_2$. In real implementations, this quantity is admittedly not infinitesimal but can always be selected sufficiently large, for example >1024. If the position code of the first data element is not equal to zero, data

elements whose position code is smaller than the position code of the first data element can also be inserted.

The use of rational numbers has the further advantage that it enables the shortest possible binary representation.

Fig. 1 shows a position code for a data element. This position code comprises the binary representation of a rational number to the base 2 in the value range]0,1[. The binary representation of the rational number comprises N=15 bits, where N*=12 data bits are present (MSB bit, bit 1 to bit 11; N*<=N), being arranged in three quadruples. The significances of the data bits are stated under the bits in each case. The data bits are preceded by three extension bits, where the quantity of extension bits specifies the quantity of data bit quadruples present. The first two extension bits are set to one and the last extension bit is set to zero. Setting the last extension bit to zero indicates that the following bits constitute data bits. With the aid of the representation selected in Fig. 1, therefore, a rational number is represented by N bits, of which N* bits comprise data bits, where N*<=N and N*=4k (in this respect, k comprises a whole number in the value range [1,α[).

Fig. 2 shows a data structure in the form of a data tree, where the position codes of the data elements have been generated with the aid of the method described above. The data structure comprises a data element A which is linked to five data elements B. Position codes P are associated with the data elements B in ascending order in the form of rational numbers 1/8, 1/4, 3/8, 1/2 and 5/8. Furthermore, the binary representations of the position codes are specified as shown in the diagram in Fig. 1.

Fig. 3 shows a data structure in accordance with Fig. 2, where two more new data elements have been inserted between the data element with the position code 3/8 and the data element with the position code 1/2. These newly added data elements are shown in gray in Fig. 3. As a result of the use of rational numbers for the position codes, two values can now be found for the position codes of the new data elements which lie between the values 3/8 and 1/2. The numbers 7/16 and 15/32 have been selected for these values in Fig. 3. It is consequently possible to generate new position codes for new data elements in the data structure without the existing position codes having to be changed. Associated position codes can therefore be retained and any desired number of new data elements inserted at any desired position.

References

[1] ISO/IEC 15938-1 Multimedia Content Description Interface - Part 1: Systems, Geneva 2002